More to Language than Picture Naming: Norms and Patient Data for a Verb Generation Task

ABSTRACT

Standardized confrontation naming is widely used to measure language impairment in persons with aphasia (PWAs). However, naming often does not reveal severity of language impairment in PWAs. We asked participants to generate verbs, given object picture stimuli. Phase 1 of this study investigates verb generation in 38 non-brain damaged participants (NCs) on 218 objects. Phase 2 examines verb generation performance of three PWAs, post-naming treatment on their subsets of objects (n=60). Preliminary data suggest that domain (i.e., living vs. artifact) affects agreement in NCs. The effects of training and practice on verb generation in PWAs are also discussed.

BACKGROUND

Confrontational naming tasks are efficient for examining word retrieval in PWA, and correlations are reported between naming skills and overall language ability (Goodglass & Wingfield, 1997). However, these tasks reveal little about patients' semantic networks. Verb generation tasks require more semantic analysis than confrontational naming tasks (Seger et al., 1999), and responses can be taken as the "lower bound" of the information activated when a person reads or hears language in naturalistic settings (McRae et al., 2005).

Most previous studies of verb generation have used neuroimaging techniques to examine brain activation patterns of normal participants (i.e., Ojemann et al., 2002; Persson et al., 2004). Verb generation has also been studied in atypical populations, including PWA (i.e., Martin & Cheng, 2006; Weiller et al., 1995). However, although many of these studies amassed small sets of normative data in order to classify stimuli into groups, none of them reported these data. Further, in these studies, analyses were not undertaken to examine participants' responses. Such data could have important clinical implications.

To date, one Spanish language study has addressed word association given the Snodgrass pictures (Fernandez, et al., 2004), despite the pictures' wide use in research and clinical populations. This study did not limit permissible responses to verbs.

The purpose of the current study is two-fold: 1) to present a set of verb association norms for a subset of the Snodgrass and Vanderwart (1980) object pictures (n=218); and 2) to investigate quantitatively and qualitatively the ways in which responses of PWAs differ from the normal sample. It is hoped that this study will provide a rich reference for clinicians and experimenters alike.

METHODS

Participants

The 38 control participants in this study (n=31 female; mean age=35.8; sd=20.3; range=19-77) were unpaid volunteers with no prior history of neurologic incident according to self-report. All

scored within normal limits on the MMSE (Folstein et al., 1975). Participants were asked to say the first two verbs that came to mind when shown each of 218 object pictures from the Snodgrass and Vanderwart (1980) set. Stimuli were presented electronically using the EPrime 2.0 software (Psychology Software Tools, Pittsburgh, PA) at the rate of one picture every five seconds. Stimuli were ordered randomly within sets created to minimize priming effects. Responses were transcribed on-line.

The three PWAs in this study were concurrently enrolled in a naming treatment study and were halfway through a Home Practice phase following short-term intensive treatment. See Table 1 for aphasia and demographic information.

Analyses

The primary measure of verb generation agreement reported in this study is the information statistic *H*, which has been shown to be more predictive of latencies in confrontation naming than variables such as print frequency or age of acquisition (Lachman, 1973; as cited in Snodgrass & Vanderwart, 1980). This statistic was computed for each object by the following formula:

$$H = \sum_{i=1}^{k} p_i \log_2(1/p_i)$$

where k is the number of different verbs generated for each picture using the first verb generated by each subject and P_i is the proportion of subjects generating each verb. Using this formula, an *H* value of 0.0 indicates perfect verb generation agreement; an *H* value of 1.00 indicates that participants generated exactly two verbs for an object with equal frequency. Failures to generate verbs (e.g., no response, 'don't know', or generation of something other than a verb) were included in percentage agreement scores, but eliminated when computing *H* values.

RESULTS

Data collection is ongoing for the verb generation norming sample; results for the first 38 "neurotypical" participants are presented here. No objects elicited perfect verb agreement (mean=0.522; sd=0.235; range: 0.105-0.974). Likewise, no objects elicited a homogenous response from each participant who generated a verb (information statistic *H* mean=2.024; sd=0.913; range: 0.037-3.978). A sample of this data, which includes the concepts eliciting the 20 highest and 20 lowest agreement statistics, is shown in Tables 2 and 3, respectively.

The majority (85%) of concepts eliciting the highest 20 *H* statistic values were artifacts (e.g., tools, furniture, vehicles, musical instruments) that were assigned the thematic role of direct or indirect object by the verbs generated. The same 85% of generated verbs represented primary functional associates for those concepts, e.g., chair/SIT, ladder/CLIMB, window/OPEN, etc. (see Table 2). In contrast, the majority (70%) of concepts eliciting the lowest 20 *H* statistic values were in the domain of living or natural objects (animals, birds, body parts). The majority (55%) of these concepts were assigned the thematic role of agent by the verbs generated. In all 20 cases, verbs that were generated by a majority of participants who generated verbs did not represent primary functional associates and in some cases were unexpected (e.g., chisel/SCREW,

thumb/POINT, well/TURN; see Table 3).

PWAs generated verbs for a subset of objects used in the normative study; specifically, objects recently treated (TR; n=20), untreated (UNTR; n=20), or consistently correct at baseline (CORR; n=20) that they have either been practicing (PR; n=30) or not (UNPR; n=30) at the midpoint of a six-month home practice program (see Table 4). ACL generated 84 verbs for 57/60 objects, including 12 that corresponded to dominant verb norms. MCR generated 20 verbs for 20/60 objects, including 5 identical to the normed set. SSM generated 43 verbs for 39/60 objects, including 17 identical to the normed set.

DISCUSSION

Although nouns and verbs are known to be processed, at least partly, in separable areas of the brain (Vigliocco et al., 2011), object and action concepts are interconnected by semantic networks, which activate associated concepts upon exposure. The number of concept associations in a semantic network is ordinarily positively related to a person's ability to retrieve a word. This study investigates typical and atypical connections between objects and verbs by presenting data from a verb generation task administered to PWAs and a normative population. Because verbs are heavily used in semantic cueing (e.g., "It barks and wags its tail"), and the effectiveness of this strategy depends upon the quality of the semantic cues, this data has implications for clinicians and researchers who serve PWA. The norms presented may be used to streamline therapy prompts and improve stimulus design.

In addition, this study reveals qualitative information about typical and atypical semantic networks. According to our norms, objects with the stronger verb associations were mostly artifacts with a primary functional association to the verbs generated, whereas objects with the weaker verb associations were mostly living objects and many of these would be assigned an agency role by the verbs generated. Performance by PWAs varied strongly from the norms and depended on object training and practice conditions.

In order to form a more complete picture of normal and atypical verb generation, we are recruiting a minimum of 22 additional males and/or representatives from racial minorities for the norming phase of this study. We are also continuing to perform detailed analyses of PWA responses.

Table 1. Aphasic Participant Demographics and BDAE (Goodglass, Kaplan, & Barresi, 2001) Selected Subtest Scores

Patient Data			Auditory Comprehension				Repetition		Naming				
Patient/ aphasia class'fn	Age when Tested	Time Post Onset when Tested	Aud. Comp. (mean of 3 %tiles)	Word Discrim.	Com-mands	Complex Ideat'l. Material	Single Word Rep'tn.	Sent-ences	(BNT) Visual Confront. Naming	Res-ponsive Naming	Animals	Tools	Actions
Maximum score:			*37*	*15*	*12*	*10*	*10*	*60*	*20*	*12*	*12*	*12*
ACL/ mod-to-severe Wern'k	58	7 yrs.	18th	29.5	10	3	6	0	23	4	6	5	6
MCR/ mod-to-severe anomia	70	12 mos.	82nd	36.5	15	9	10	7	37	12	10	4	6
SSM/ mild anomia	63	25 mos.	83rd	36	15	10	10	9	48	20	10	9	10

Table 2. Verbs generated with highest twenty *H* statistic agreement

#	Object	Dominant Verb	Dominant Verb Print Frequency	Dominant Verb Info Stat (H)	Dominant Verb % Agreement	Object Thematic Role	LIVING vs ARTIFACT	PRIMARY FUNCTIONAL ASSOCIATE?
1	**chair**	SIT	67	0.037	0.974	IO	ARTIFACT	Y
2	**scissors**	CUT	192	0.037	0.974	IO	ARTIFACT	Y
3	**finger**	POINT	395	0.176	0.974	MIXED	*LIVING*	*N*
4	**piano**	PLAY	200	0.176	0.974	DO	ARTIFACT	Y
5	**pipe**	SMOKE	41	0.176	0.974	DO	ARTIFACT	Y
6	**ruler**	MEASURE	91	0.212	0.947	IO	ARTIFACT	Y
7	**door**	OPEN	319	0.247	0.921	DO	ARTIFACT	Y
8	**lemon**	EAT	61	0.289	0.289	DO	*LIVING*	*N*
9	**kite**	FLY	33	0.297	0.947	DO	ARTIFACT	Y
10	**helicopter**	FLY	33	0.350	0.947	MIXED	ARTIFACT	Y
11	**ladder**	CLIMB	12	0.350	0.947	DO	ARTIFACT	Y
12	**comb**	COMB	12	0.385	0.921	IO	ARTIFACT	Y
13	**airplane**	FLY	33	0.471	0.921	MIXED	ARTIFACT	Y
14	**knife**	CUT	192	0.471	0.921	IO	ARTIFACT	Y
15	**toothbrush**	BRUSH	44	0.471	0.921	IO	ARTIFACT	Y
16	**lock**	LOCK	23	0.524	0.921	IO	ARTIFACT	Y
17	**top**	SPIN	5	0.524	0.921	DO	ARTIFACT	Y
18	**bell**	RING	47	0.643	0.895	DO	ARTIFACT	Y
19	**banana**	PEEL	3	0.643	0.895	DO	*LIVING*	*N*
20	**window**	OPEN	319	0.696	0.895	DO	ARTIFACT	Y
		MEAN	106.10					
		SD	120.21					

Table 3. Verbs generated with lowest twenty *H* statistic agreement

#	Object	Dominant Verb	Dominant Verb Print Frequency	Dominant Verb Info Stat (H)	Dominant Verb % Agreement	Object Thematic Role	LIVING vs ARTIFACT	PRIMARY FUNCTIONAL ASSOCIATE?
199	**chicken**	LAY	139	3.235	0.158	*Agent*	*LIVING*	N
200	**donkey**	WALK	100	3.241	0.237	*Agent*	*LIVING*	N
201	**chain**	LINK	16	3.271	0.184	IO	ARTIFACT	N
202	**chisel**	SCREW	21	3.298	0.158	IO	ARTIFACT	N
203	**bear**	GROWL	4	3.300	0.211	*Agent*	*LIVING*	N
204	**goat**	WALK	100	3.308	0.263	*Agent*	*LIVING*	N
205	**thumb**	POINT	395	3.317	0.158	MIXED	LIVING	N
206	**alligator**	SWIM	15	3.372	0.184	*Agent*	*LIVING*	N
207	**raccoon**	WALK	100	3.390	0.158	*Agent*	LIVING	N
208	**arm**	LIFT	23	3.405	0.184	DO	*LIVING*	N
209	**toe**	STUB	3	3.504	0.158	DO	LIVING	N
210	**fence**	CLIMB	12	3.567	0.158	DO	ARTIFACT	N
211	**clock**	TICK	3	3.594	0.132	*Agent*	ARTIFACT	N
212	**peacock**	WALK	100	3.623	0.158	*Agent*	*LIVING*	N
213	**well**	TURN	233	3.754	0.158	IO	ARTIFACT	N
214	**barn**	STORE	74	3.826	0.158	IO	ARTIFACT	N
215	**rooster**	CROW	2	3.846	0.105	*Agent*	*LIVING*	N
216	**monkey**	CLIMB	12	3.857	0.132	*Agent*	*LIVING*	N
217	**squirrel**	RUN	212	3.869	0.184	*Agent*	*LIVING*	N
218	**hand**	TOUCH	87	3.978	0.158	*Agent*	*LIVING*	N
		MEAN	82.55					
		SD	100.82					

Table 4. Aphasic Participant Verb Generation Post-treatment

Participant	# Legitimate Verbs Generated	# Unique Verbs	# Matching Normed Dominant Verbs	% Verbs Generated from CORR Objects	% Verbs Generated from TR-PR Objects	% Verbs Generated from TR-UNPR Objects	% Verbs Generated from UNTR-PR Objects	% Verbs Generated from UNTR-UNPR Objects
ACL	45	20	12	**0.56**	**0.2**	0.02	**0.18**	0.04
MCR	20	18	5	**0.8**	**0.2**	0	0	0
SSM	36	30	17	**0.36**	0.11	**0.19**	**0.19**	0.14

CORR: consistently correct at baseline
TR-PR: targeted in treatment and home practice
TR-UNPR: targeted in treatment, not home practice
UNTR-PR: targeted in home practice, not treatment
UNTR-UNPR: not targeted in treatment or home practice

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